

APPENDIX A

FIELD SAMPLING AND ANALYSIS PLAN SURFACE SOIL AT THE IRON MOUNTAIN ROAD RANGES FORT MCCLELLAN, CALHOUN COUNTY, ALABAMA

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Appendix A

Field Sampling and Analysis Plan

Surface Soil at the Iron Mountain Road Ranges

Fort McClellan, Calhoun County, Alabama

1.0 Introduction

As presented in the baseline ecological risk assessment (BERA) problem formulation for the Iron Mount Road (IMR) ranges (IT Corporation [IT], 2002a), four inorganic constituents (antimony, copper, lead, and zinc) were identified as chemicals of potential ecological concern (COPEC) for receptors located at the small arms ranges at IMR. As part of the BERA, surface soil (0 to 0.5 feet below ground surface) will be collected from within the investigation area and analyzed for toxicity to earthworms. Additionally, soil-to-worm accumulation factors will be developed for use in food chain modeling to higher trophic level receptors that reside within the IMR ranges.

2.0 Selection of Sample Locations

Sample locations for the BERA are based on the three different soil types identified at the IMR and Bains Gap Road (BGR) ranges (low, medium, and high metal-binding capacity soils) and the gradient of lead detected in these soils. A more detailed discussion of the designation of soils based on their relative metal-binding capacity is presented in Section 3.0 of this report. Because lead has been identified as a COPEC at all of the IMR ranges and has been used as one of the indicators of potential contamination from Army activities at small arms ranges at Fort McClellan, ecological sample locations will be based upon lead concentrations.

Neuhäuser, et al. (1985) studied acute effects of lead to the earthworm (*Eisenia fetida*) using an artificial soil (pH 6), and estimated a 14-day lethal concentration killing 50 percent of the test population (LC₅₀) of 5,940 parts per million (ppm) lead as Pb(NO₃). Further, *E. fetida* studies by Spurgeon, et al. (1994) estimated a 56-day lead LC₅₀ as Pb(NO₃)₂, of 3,760 ppm using artificial soil at pH 6.3. Based on these tested concentrations of lead in soil that cause earthworm toxicity and the range of lead concentrations detected in IMR range soils, a lead concentration gradient was established within which samples will be collected and tested. A concentration gradient approach will be used in which sample locations will be selected for five different lead concentrations. The five lead concentrations that will be sampled from each of the three soil types are the following:

- 100 milligrams per kilogram (mg/kg) - 799 mg/kg (low concentration range)
- 800 mg/kg - 9,999 mg/kg (medium-low concentration range)

- 10,000 mg/kg - 19,999 mg/kg (medium concentration range)
- 20,000 mg/kg - 99,999 mg/kg (medium-high concentration range)
- 100,000 mg/kg - 116,000 mg/kg (high concentration range).

In addition, one surface soil sample will be collected from each of the five different soil mapping units in non-impacted areas within or adjacent to Fort McClellan. These five soil samples will serve as reference soils for the toxicity and bioaccumulation tests described herein.

Figures 5-1, 5-2, and 5-3 present the approximate locations of the surface soil samples representative of the lead concentration gradients within the three different soil types. It is important to note that in order to sample the entire lead concentration gradient within each of the three soil types, it will be necessary to collect surface soil samples from both the IMR ranges and the Bains Gap Road ranges.

3.0 Sampling and Analysis Requirements

The following presents sampling and analysis requirements for the collection of soil for the use in the earthworm toxicity and bioaccumulation studies in conjunction with the BERA for the IMR ranges.

3.1 Sample Confirmation

Prior to the collection of soil for analytical and toxicological testing, lead concentrations at the selected sample locations will be screened *in situ* using x-ray fluorescence technology to verify that the selected locations are appropriate (i.e., lead concentration) for the intended lead gradient. X-ray fluorescence methodology will follow the procedures outlined in the installation-wide sampling and analysis plan (IT, 2002b).

3.2 Sample Collection Procedures

Once the lead concentrations have been confirmed using x-ray fluorescence, soil will be collected to a depth of 0.5 feet, using a stainless-steel hand auger or spoon, and homogenized in a stainless-steel bowl following the sampling procedures outlined in the installation-wide sampling and analysis plan (IT, 2002b). Soil samples will then be transferred to the appropriate sample containers.

3.3 Decontamination Procedures

All equipment used for collection, homogenization, and transfer will be properly decontaminated prior to collecting samples and between sampling locations, as described in the installation-wide sampling and analysis plan (IT, 2002b).

3.4 Quality Assurance/Quality Control Samples

As established by the data quality objectives process, field and laboratory quality assurance/quality control indicator soil samples and analyses will be collected to provide information concerning the measured quality and usability of the field data. As presented in the installation-wide sampling and analysis plan (IT, 2002b), the frequency of field duplicates, matrix spike/matrix spike duplicates, and equipment rinse blanks will be 1 in 10 (10 percent), 1 in 20 (5 percent), and once per sampling event, respectively.

As presented in the earthworm toxicity/bioaccumulation protocol (Section 3.6), both a reference and laboratory control sample will be used to ensure the quality of biological testing.

3.5 Sample Labeling, Packaging, and Shipment

All prepared samples will be labeled, packaged, and shipped to the appropriate analytical or biological testing laboratory as presented in the installation-wide sampling and analysis plan (IT, 2002b).

3.6 Analysis

3.6.1 Chemical Analyses

As presented in Table A-1, chemical analyses of soils collected for earthworm toxicity and bioaccumulation studies will include target analyte list (TAL) metals, total organic carbon, pH, and grain size. Chemical analyses of earthworm tissue after termination of the toxicity tests will include TAL metals (Table A-2).

3.6.2 Biological Testing

Surface soil used for earthworm toxicity and bioaccumulation testing will be “split” from the soil samples used for chemical analysis. The 14-day earthworm survival tests and the earthworm bioaccumulation tests will be conducted using the earthworm *E. fetida*.

3.6.2.1 Test Initiation

Earthworm toxicity/bioaccumulation tests will begin within 48 hours of test soil collection. Immediately prior to testing, the temperature of the test soils will be adjusted to 20 ± 2 degrees Celsius ($^{\circ}\text{C}$). Test conditions are presented in Table A-3.

Test soils will be hydrated with deionized water to create a moist testing environment. The earthworm test soils will be hydrated to 75 percent of water holding capacity.

Ten earthworms will be placed into each of five replicate containers each containing 200 grams (dry weight) of test soil.

The earthworms will be placed on the surface of the test soil in a pint jar, capped, and secured. The tests will be incubated within an environmental chamber to give soil temperature of $20 \pm 2^{\circ}\text{C}$ under continuous light.

Lighting will be at continuous ambient laboratory levels, which is approximately 540 to 1,080 lux, with no shading.

3.6.2.2 Termination of the Test

Mortality will be assessed after 7 days and at the termination of the test (14 days) by emptying the test soil onto a tray and sorting the worms from the soil. Dead worms will be removed from the test soil and the 7-day mortality rate will be noted. Live worms will be placed back into their test jars and placed on the surface of the soil. The numbers of live and dead worms in each test chamber will be recorded at the termination of the test (14 days) and all living worms will be preserved in separate containers for COPEC whole-body burden analysis.

3.6.2.3 Acceptability of Test Results

For test results to be acceptable, mean survival in the laboratory control tests must be at least 90 percent.

4.0 Data Interpretation

The effect measured in the earthworm toxicity tests is death, while the effect measured in the earthworm bioaccumulation tests is COPEC concentration within whole earthworm tissue. Results of the toxicity and bioaccumulation testing will be interpreted as described in Section 6 of the IMR BERA study design report.

5.0 Safety and Health and Unexploded Ordnance Support

All work conducted during the BERA study design for the IMR ranges will be conducted in accordance with the site specific safety and health plan and site-unexploded ordnance safety plan attachments to the site-specific field sampling plan for the ranges at Iron Mountain Road and ranges at Bains Gap Road, August 2001. These attachments will be updated to be consistent with the February 2002 *Draft Revision 3, Installation-Wide Sampling and Analysis Plan, Fort McClellan, Calhoun County, Alabama*, for the final version of the BERA study design for IMR ranges.

6.0 References

IT Corporation (IT), 2002a, *Draft Baseline Ecological Risk Assessment Problem Formulation for Small Arms Ranges at Iron Mountain Road, Fort McClellan, Calhoun County, Alabama*, August.

IT Corporation (IT), 2002b, *Draft Revision 3, Installation-Wide Sampling and Analysis Plan, Fort McClellan, Calhoun County, Alabama*, February.

Neuhauser, E. F., R. C. Loehr, D. L. Milligan, and M. R. Malecki, 1985, "Toxicity of Metals to the Earthworm *Eisenia fetida*", *Biol. Fertil. Soils*, 1: 149 - 152.

Spurgeon, D. J., S. P. Hopkin, and D. T. Jones, 1994, "Effects of Cadmium, Copper, Lead, and Zinc on Growth, Reproduction, and Survival of the Earthworm *Eisenia fetida* (Savigney): Assessing the Environmental Impact of Point Source Metal Contamination in Terrestrial Ecosystems," *Environ. Pollut.*, 84: 123 – 130.

Table A-1

**Surface Soil Sample Designations and QA/QC Sample Quantities
BERA Study Design
for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
HR-75Q-SS03	HR-75Q-SS03-SS-RW0001-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-85-SS37	SAR-85-SS37-SS-RW0002-REG	0-0.5	SAR-85-SS37-SS-RW0003-FD			TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-85-SS34	SAR-85-SS34-SS-RW0004-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-71-SS05	SAR-71-SS05-SS-RW0005-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-71-SS09	SAR-71-SS09-SS-RW0006-REG	0-0.5			SAR-71-SS09-SS-RW0006-MS/MSD	TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
LMBC-REF1	LMBC-REF1-SS-RW0007-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
LMBC-REF2	LMBC-REF2-SS-RW0008-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
LMBC-REF3	LMBC-REF3-SS-RW0009-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
HR-77Q-SS01	HR-77Q-SS01-SS-RW0010-REG	0-0.5	HR-77Q-SS01-SS-RW0011-FD			TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-78-SS34	SAR-78-SS34-SS-RW0012-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-77-SS33	SAR-77-SS33-SS-RW0013-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
HR-80Q-MW02	SAR-80Q-MW02-SS-RW0014-REG	0-0.5			SAR-80Q-MW02-SS-RW0014-MS/MSD	TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test

Table A-1

**Surface Soil Sample Designations and QA/QC Sample Quantities
BERA Study Design
for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-77-SS50	SAR-77-SS50-SS-RW0015-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
MMBC-REF	MMBC-SS-RW0016-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-78-SS35	SAR-78-SS35-SS-RW0017-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-78-SS25	SAR-78-SS25-SS-RW0018-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-78-SS17	SAR-78-SS17-SS-RW0019-REG	0-0.5	SAR-78-SS17-SS-RW0020-FD			TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-69-SS11	SAR-69-SS11-SS-RW0021-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
SAR-85-SS02	SAR-85-SS02-SS-RW0022-REG	0-0.5			SAR-85-SS02-SS-RW0022-MS/MSD	TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test
HMBC-REF	HMBC-SS-RW0023-REG	0-0.5				TAL Metals by SW6010B/SW7471A, TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and Earthworm Survival Test

FD - Field duplicate.

FS - Field split.

MS/MSD - Matrix spike/matrix spike duplicate.

QA/QC - Quality assurance/quality control.

REG - Field sample.

TAL - Target Analyte List.

TOC - Total Organic Carbon

LMBC-REF- Low Metal-Binding Capacity Reference Soil

MMBC-REF- Medium Metal-Binding Capacity Reference Soil

HMBC-REF- High Metal-Binding Capacity Reference Soil

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
HR-75Q-SS03	HR-75Q-SS03-BIOA-RW7001W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7002W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7003W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7004W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7005W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7006W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7007W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7008W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7009W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7010W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SS37	SAR-85-SS37-BIOA-RW7011W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7012W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7013W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7014W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7015W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7016W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7017W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7018W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7019W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7020W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SS34	SAR-85-SS34-BIOA-RW7021W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7022W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7023W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7024W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7025W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7026W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7027W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7028W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7029W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7030W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-71-SS05	SAR-71-SS05-BIOA-RW7031W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7032W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7033W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7034W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7035W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7036W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7037W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7038W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7039W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7040W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-71-SS09	SAR-71-SS09-BIOA-RW7041W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7042W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7043W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7044W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7045W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7046W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7047W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7048W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7049W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7050W-REG	N/A				TAL Metals by SW6010B/SW7471A
LMBC-REF1	LMBC-REF1-SS-BIOA-RW7051W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7052W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7053W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7054W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7055W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7056W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7057W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7058W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7059W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7060W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
LMBC-REF2	LMBC-REF2-SS-BIOA-RW7061W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7062W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7063W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7064W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7065W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7066W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7067W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7068W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7069W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7070W-REG	N/A				TAL Metals by SW6010B/SW7471A
LMBC-REF3	LMBC-REF3-SS-BIOA-RW7071W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7072W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7073W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7074W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7075W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7076W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7077W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7078W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7079W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7080W-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-77Q-SS01	HR-77Q-SS01-BIOA-RW7081W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7082W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7083W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7084W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7085W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7086W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7087W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7088W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7089W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7090W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-78-SS34	SAR-78-SS34-BIOA-RW7091W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7092W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7093W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7094W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7095W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7096W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7097W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7098W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7099W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7100W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-77-SS33	SAR-77-SS33-BIOA-RW7101W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7102W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7103W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7104W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7105W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7106W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7107W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7108W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7109W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7110W-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-80Q-MW02	HR-80Q-MW02-BIOA-RW7111W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7112W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7113W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7114W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7115W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7116W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7117W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7118W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7119W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7120W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-77-SS50	SAR-77-SS50-BIOA-RW7121W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7122W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7123W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7124W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7125W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7126W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7127W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7128W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7129W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7130W-REG	N/A				TAL Metals by SW6010B/SW7471A
MMBC-REF	MMBC-REF-BIOA-SW7131W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7132W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7133W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7134W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7135W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7136W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7137W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7138W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7139W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-SW7140W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS35	SAR-78-SS35-BIOA-RW7141W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7142W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7143W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7144W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7145W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7146W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7147W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7148W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7149W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7150W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-78-SS25	SAR-78-SS25-BIOA-RW7151W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7152W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7153W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7154W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7155W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7156W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7157W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7158W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7159W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS17	SAR-78-SS17-BIOA-RW7161W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7162W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7163W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7164W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7165W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7166W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7167W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7168W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7169W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-69-SS11	SAR-69-SS11-BIOA-RW7171W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7172W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7173W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7174W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7175W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7176W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7177W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7178W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7179W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7180W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

**Earthworm Tissue Sample Designations and QA/QC Sample Quantities
BERA Study Design for Ranges at Iron Mountain Road and Bains Gap Road
Fort McClellan, Calhoun County, Alabama**

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Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-85-SS02	SAR-85-SS02-BIOA-RW7181W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7182W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7183W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7184W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7185W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7186W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7187W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7188W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7189W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7190W-REG	N/A				TAL Metals by SW6010B/SW7471A
HMBC-REF	HMBC-REF-BIOA-RW7191W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7192W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7193W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7194W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7195W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7196W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7197W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7198W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7199W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7200W-REG	N/A				TAL Metals by SW6010B/SW7471A
BIO-REF	BIO-REF-BIOA-RW7201W-REG	N/A				TAL Metals by SW6010B/SW7471A

FD - Field duplicate.

FS - Field split.

MS/MSD - Matrix spike/matrix spike duplicate.

QA/QC - Quality assurance/quality control.

REG - Field sample.

TAL - Target Analyte List.

TOC - Total Organic Carbon

LMBC-REF- Low Metal-Binding Capacity Reference Soil

MMBC-REF- Medium Metal-Binding Capacity Reference Soil

HMBC-REF- High Metal-Binding Capacity Reference Soil

BIO-REF- Worm Tissue Reference

Table A-3

**Summary of Test Conditions for *E. fetida* Survival and Bioaccumulation Test
IMR Ranges BERA Study Design
Fort McClellan, Calhoun County, Alabama**

1. Test Type	Static
2. Soil temperature (°C)	20 ±2°C
3. Light quality	Ambient laboratory light
4. Light intensity	540-1,080 lux
5. Photoperiod	Continuous illumination
6. Test vessel type and size	1-pint glass canning jars with rings and lids; 1/8-inch air hole
7. Test soil mass	200g
8. Test soil pH*	≥4 but ≤10
9. Artificial soil (% weight) (Control)	10% 2.36-mm screened sphagnum peat, 20% colloidal kaolinite clay, and 70% grade 70 silica sand
10. Test soil moisture content	75% water holding capacity
11. Renewal of test materials	None
12. Age of test organisms	≥60 days
13. Number of test organisms per chamber	10
14. Number of replicate chambers	5
15. Feeding regime	As needed
16. Dilution factor	None (100% undiluted site soil)
17. Test duration	14 days
18. Effect measured	Death and tissue analysis for COPEC burdens

°C - Degrees Celsius.

g - Gram.

mm - Millimeter.

COPEC - Constituent of potential concern.